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Terminology among the Orders of Thallophytes.

By Lucien Marcus Underwood.

"To understand things in their proper relations is an important part of a student's education." In Botany, as in other subjects of extensive specialization, the student often fails to get the bearings of his subject, and in his presentation shows an utter lack of what may be called botanical perspective. One cause of this failure is the disposition, now happily growing less, to become botanists without knowing plants ; without knowing them in their gross characters as well as their microscopic, in the field in their native haunts, as well as in the paraffin bath ; in their natural environment as factors in a life-struggle for existence, as well as with only an environment of celloidin. We have had instances galore of young men without this perspective who have been skilled manipulators of microscopic machinery and little more, whose productions were studies without relations, complete and excellent in themselves, but without any recognized or recognizable bearings on botanical science. May we be protected from a prospective crop of graduates under the inflowing tide of physiological botany, which promises to be the next wave of the subject that sweeps the country, for of all men who do not know plants as a part of their preparation it seems as though the physiological botanist could be capable of the most harm of any.

A second reason why this lack of perspective is sometimes so apparent is the failure to grasp clearly the system of relations existing among the various groups of plants. This is partly the fault of those who present the subject, some of whom are the products of the extreme reaction against the old and meaningless method of study of botany ; partly the fault of the makers of the systems themselves. It is of this last feature that I would speak at some length.

The average student, or even the brightest one, looking through a series of modern text-books, especially those treating of the lower plants, would probably be lost in a maze at the diverse systems of terminology and subdivision that are there presented, and if he saw signs of a real system among the various combinations proposed he would get at best an indistinct notion of relationships and coördinations. While nature does not draw many hard and fast lines, it is still possible to present in a somewhat simple manner a conspectus of the groups of living things she does develop. It is the purpose of this paper to suggest some methods in which these relations can be more satisfactorily presented to our students, with less possibility of giving them a confused conglomeration of unrelated categories.

In order to show more clearly the extent of this confusion I have selected for an illustration the group of the Ascomycetes, with particular notice of the allies of *Peziza*, and will show in parallel columns their arrangement in groups by some of the modern authors. I select this group for several reasons, among others the fact that it has been recently treated by several specialists in fungi, although most or all of them are naturally more or less influenced by the extensive researches of Brefeld. It is also a group that contains very diverse elements and permits of numberless combinations based on real or supposed relationships. (See table next page.)

Of the above statements of a system, that of Von Tafel, conservatively cautious and indefinite, is entirely silent on the group names; coördinate groups only are recognized and these may probably be taken as the conception of these relations held by Brefeld himself.

Rehm consistently uses the term " Familie " as subordinate to " Ordnung," but complicates his system by the introduction of two additional groups between order and family, " Hauptordnung " and " Unterordnung." His family names lack uniformity as seen in the examples *Exoasci*, *Dothidiaceae*, *Ascoboleae*. In fact the termination *-aceae* is used by him for groups of at least four different ranks, as: *Hysteriaceae* (Ordnung) *Pezizaceae* (Hauptordnung), *Sphaeriaceae* (Unterordnung), and *Hypocreaceae* (Familie).

Although Schroeter does not so characterize each group distinctively as "order" or " family;" their rank is clearly implied in the context and the termination *-aceae* is consistently used for the family. His ordinal groups, though mostly natural ones, lack uniformity and are often complicated in pronunciation, *e.g.*, Phacidiineae, Pyrenomycetineae, Hysteriineae.

*F. Von Tafel.**	*H. Rehm.*†	*J. Schroeter.*‡	*W. Zopf.*§	*S. H. Vines.*‖	*E. Warming.*¶
ASCOMYCETEN	3. Classe. ASCOMYCETES	II. ASCOMYCETES	Gruppe IV. ASCOMYCETEN	Sub-class 4. ASCOMYCETES	Sub-class ASCOMYCETES
Exoasci	1. Ord. Gymnoasceae	Hemiasceae	Ord. 1. Gymnoasceen	Ord. 1. Gymnoasceae	Series 1. Exoasci
Endomyceten	*Fam. Exoasci*	1. Hemiascineae	*Fam. 1. Saccharomyces*	Ord. 2. Pyrenomycetes	Series 2. Carpoasci
Taphrineen	*Fam. Gymnoasci*	Euasceae	*Fam. 2. Exoasci*	Sub-ord. Perisporiaceae	Fam. Gymnoascales
Carpoasci	2. Ord. Pyrenomycetes	2. Protoascineae	*Fam. 3. Gymnoasci*	Sub-ord. Tuberaceae	Fam. Perisporiales
Gymnoasceen	Unterord. Perisporiaceae	3. Protodiscineae	Ord. 2. Perisporiaceen	Sub-ord. Hypocreaceae	*Ord. Erysiphaceae*
Perisporiaceen.	(*2 families*)	4. Helvellineae	*Fam. 1. Erysipheen*	Sub-ord. Sphaeriaceae	*Ord. Perisporiaceae*
Erysipheen	Unterord. Hypocreaceae	5. Pezizineae	*Fam. 2. Aspergilleen*	Sub-ord. Dothidiaceae	*Ord. Tuberaceae*
Perisporieen	*Fam. Hypocreaceae*	*Pyrenemaceae*	*Fam. 3. Tuberaceen*	Ord. 3. Discomycetes	Fam Pyrenomycetes
Tuberaceen	Unterord. Sphaeriaceae	*Pezizaceae*	Ord. 3. Sphaeriaceen	Sub-ord. Pezizaceae	Sub-fam. Hypocreales
Pyrenomyceten	(*18 families*)	*Ascobolaceae*	*Fam. 1. Sphaerieen*	*Fam. Phacidieae*	*Ord. Hypocreaceae*
Hypocreaceen	Unterord. Dothidiaceae	*Mollisiaceae*	*Fam. 2. Hypocreaceen*	*Fam. Pezizeae*	Sub-fam. Sphaeriales
Sphaeriaceen	*Fam. Dothidiaceae*	*Celidiaceae*	*Fam. 3. Xylarieen*	*Fam. Bulgarieae*	(*18 orders*).
Dothideaceen	3. Ord. Hysteriaceae	*Patellariaceae*	*Fam. 4. Hysteriaceen*	"etc , etc."	Sub-fam. Dothideales
Hysteriaceen	4. Ord. Discomycetes	*Cenangiaceae*	Ord. 4. Discomycetes	Sub-ord. Helvellaceae	*Ord. Dothideaceae*
Discomyceten	1. Hauptord. Pezizaceae	*Cordieritidaceae*	*Fam. 1. Pezizaceen*		Fam. Hysteriales
Phacidiaceen	1. Unterord. Phacidiaceae	*Cyttariaceae*	*Fam. 2. Helvellaceen*		Fam. Discomycetes
Stictideen	2. " Stictideae	6. Phacidiineae			Sub-fam. Phacidiales
Tryblidiaceen	3. " Tryblidieae	7. Hysteriineae			Sub-fam. Stictidales
Dermateaceen	4. " Dermateaceae	8. Tuberineae			Sub-fam. Tryblidiales
Pezizaceen	5. " Pezizeae	8. Plectascineae			Sub-fam. Dermateales
Helotieen	*Fam. Mollisieae*	10. Pyrenomycetineae			Sub-fam. Pezizales
Mollisieen	*Fam. Helotieae*				*Ord. Helotiaceae*
Ascoboleen	*Fam. Eupezizeae*				*Ord. Mollisiaceae*
Pezizeen	*Fam. Ascoboleae*				*Ord. Pezizaceae*
Helvellaceen	2. Hauptord. Helvellaceae				*Ord. Ascobolaceae*
	Fam. Rhizineae				Fam. Helvellales
	Fam. Geoglosseae				*Ord. Helvellaceae*
	Fam. Helvelleae				
	5. Ord. Tuberaceae				
	Fam. Eutuberaceen				
	Fam. Balsamieen				
	Fam. Elaphomycetineen				

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* Vergleichende Morphologie der Pilze, 1892.

† Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz. **1**: II., III., V., Abtheilung, 1884–1896 (Abt. V., by E. Fischer).

‡ Engler-Prantl: Die natürlichen Pflanzenfamilien. **1**: 142–224, 1894–1896. The portion after p. 178 continued by G. Lindau, who justly criticizes Schroeter's blunder of arrangement whereby the highest orders are sandwiched between lower ones.

§ Die Pilze in Schenk: Handbuch der Botanik. **4**: 271–755, 1890.

‖ A Student's Text-Book of Botany, 294–303, 1894.

¶ Haandbog i den Systematiske Botanik, 1892. (Translated by M. C. Potter, 1895, with revision of the Fungi, by Dr. E. Knoblauch).

The systems adopted by both Zopf and Vines are manifestly incomplete and are inserted simply to show the conspectus given in two standard works that have an extensive circulation in this country.

Warming's system is in some respects the most consistently carried out, but he introduces too many intermediate groups for clearness and most unaccountably makes the group *order* subordinate to *family* or even in some cases to *sub-family*. His group name *series* is not to be recommended for a group subordinate to a class.

The systems in use have thus been made confusing: (1) By lack of uniformity in terminations so that the relative rank of a group name cannot be told from its termination; (2) By confusing the usually accepted sequence of group names, so that the usual order of phylum (series), class, order and family is varied or even inverted; (3) By the use of numerous and confusing intermediate group-names which may be adapted to a monograph where details are entered into more minutely, but are out of place for presentation in a general way where clearness and simplicity ought to prevail; and finally, (4) By attempting to preserve old group names that no longer have a place in the system because they represent heterogeneous groups co rdinate with nothing now recognized.

It would seem that certain fundamental principles of terminology could be adopted that would vastly simplify the matter of a system of plants and, once in use, enable a student to more intelligently grasp the relationships of plants without subjecting him to this irregular and confusing terminology. Groups will change their limits with our increasing knowledge; new groups will appear and the system of relationships be modified with each generation, but a set form of expression once adopted might become as easy of comprehension as the simple principle involved in binomial nomeclature. Among the features of such a form of expression are:

1. The two group names above the genus should be definitely fixed and their sequence rigidly maintained. The termination *aceae* should be reserved for families in accordance with well known and long existing usage among the higher plants. To

make this termination significant every time, it should appear nowhere in the system outside of family names.

2. For the ordinal name no termination could be better than that of *-ales*.* Long usage as a " Cohort " name, simplicity of affixing and pronunciation, clearness and brevity, all recommend it. If used it ought to be used *exclusively* for orders; it would then characterize at sight the rank of the group name as the termination *-idae* does the family in zoölogy.

3. The names should as far as possible be affixed to the names of representative genera or, if not, be derived from some striking characteristic or feature of the group. Family names, for obvious reasons, should always be of the former class.

4. Miscellaneous group names need not be retained after their usefulness in the system ceases to exist. Where an older name occurs which is practically an order, in the modern sense, it is desirable, where simplicity can be preserved, to so modify the old name as to conform in termination with the new system, but the rules of priority accepted for genera and species need not necessarily apply to either family or ordinal names. It would seem better to attain uniformity of usage by other means.

As a further means of illustrating this simplicity I append the ordinal groups that I am accustomed to use in presenting the relationships of the fungi to students. Nothing is claimed for it except an adaptation of the principles above recommended to the system believed to be nearest in accord with modern research.†

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* Compare the discussion of this subject, this journal, **22**: 124–129. It is only fair to state that when that paper on the classification of the Archegoniates was written I had not seen Engler's *Syllabus der Vorlesungen*, which contains certain divisions similar to those suggested in my paper and necessarily antedating it. He uses the same termination *-ales* for orders, but not uniformly, nor exclusively for groups of that rank.

† At present I am using the following presentation of the leading groups of Algae:

Class BACILLARIAE—with one order: DIATOMALES

Class CYANOPHYCEAE—with 4 orders: CHROOCOCCALES, OSCILLARIALES, NOSTOCALES, SCYTONEMALES.

Class CHLOROPHYCEAE—with 6 orders: PROTOCOCCALES, CONJUGALES, SIPHONALES, CONFERVALES, COLEOCHAETALES, CHARALES.

Class PHAEOPHYCEAE—with 3 orders: PHAEOSPORALES, DICTYOTALES, FUCALES.

Class RHODOPHYCEAE—with 5 orders: BANGIALES, NEMALIONALES, CRYPTONEMIALES, GIGARTINALES, RHODYMENIALES.

Series FUNGI of the Phylum THALLOPHYTA.

Class PHYCOMYCETES (Algal-fungi).[*]
  Order Chytridiales. (Algal parasites).
  Order Mucorales. (Moulds).
  Order Entomophthorales. (Insect parasites.)
  Order Saprolegniales. (Aquatic moulds.)
  Order Peronosporales. (Downy mildews.)
Class ASCOMYCETES. (Spore-sac fungi.)
  Order Hemiascales.
  Order Protoascales. (Yeast fungi.)
  Order Gymnoascalfs. (Plum pockets.)
  Order Perisporiales. (Powdery mildews, etc.)
  Order Hypocreales.[†]
  Order Sphaeriales. }
  Order Dothideales. } Black-fungi (Pyrenomycetes).
  Order Laboulbeniales.[‡]
  Order Tuberales. (Truffles.)
  Order Hysteriales.
  Order Phacidiales. }
  Order Pezizales. } Cup-fungi (Discomycetes).
  Order Helvellales. (Morels, etc.)

(Fungi Imperfecti.)[§]

  Order Hyphales. (Hyphomycetes.)
  Order Melanconiales.
  Order Sphaeropsidales. (Spot fungi.)

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[*] Fischer's arrangement of these forms in the order of their simpliclty of reproduction and structure seems highly satisfactory. The first order forms the sub-class *Archimycetes*, with usually asexual methods of reproduction. The second and third form the *Zygomycetes*, their sexual reproduction being by conjugation. The last two orders form the *Oomycetes* in which sexual reproduction is sufficiently differentiated, so that the egg forms the passive as the antherid forms the active element.

[†] It is with some misgivings that this group is left as a coördinate group with the next, since it differs from it chiefly in the color and consistency of the stroma.

[‡] This remarkable group, whose development is one of the triumphs of American botany, is surely worthy of ordinal rank. It is remarkable that only one of the authors quoted, mentions this extensive group, and then only as an "Anhang" to the Pyrenomycetes. And still there are Germaniacs among American botanists who continue to claim that American botany is nothing.

[§] This unfortunate group is the *bête noir* of the systematist. That some of these forms are not now connected with any ascigerous form is certain. That a considerable number of them have always had a complete autonomy is highly probable.

Class BASIDIOMYCETES.

Order USTILAGINALES. (Smuts.)
Order UREDINALES. (Rusts.)
Order TREMELLALES. (Gelatinous fungi.)
Order HYMENIALES. (Mushrooms, etc.)
Order GASTRALES. (Puff balls, etc.)

In case the slime moulds and Bacteria are not to be relegated to the domain of animal life, as has been time and again suggested, they would properly form classes lower than the Phycomycetes, *viz.:* MYXOMYCETES with the Order Acrasiales, Plasmodiophorales and Myxogastrales; and SCHIZOMYCETES with the Orders Eubacteriales and Myxobacteriales. *

There still remains the systematic position of the Lichens. Since the coördination of the orders of the entire phylum Thallophyta is far from being settled owing to the limitations of our knowledge, and since the two main series, separated from each other by physiological rather than structural or morphological characters, are held apart largely as a matter of convenience, it may be better to likewise hold the lichens apart as a separate group, though the reasons therefor are much less apparent than in the separation of the algae and the fungi. The lichens are distinctively fungi and there is no more real reason for holding them apart from the fungous orders with which they intergrade than there would be in separating other parasitic forms in distinct series because of some supposed mutualism between the parasite and its host. The fact that the lichens have been treated apart from their real alliances has doubtless been the cause of some part of the confusion relating to them. The orders Pyrenolichenales, Discolichenales, Hymenolichenales and Gastrolichenales may therefore be sandwiched in among their nearest alliances in the conspectus. If held apart in a distinct series it must be understood as a matter of expediency and convenience and not an indication of natural affinity among diverse groups such as they really are.

9 DECEMBER, 1896.

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* Cf. Thaxter, Bot. Gazette, 17: 389–406. D 1892.